CLAIMS

1. A microfluidic system comprising:

a substrate

a cell sorting system formed on the substrate for sorting cells based on a predetermined characteristic; and

a screening system formed on the substrate for screening cells, said screening system having a mixing region for mixing cells having the predetermined characteristic with a test compound and a detection region for detecting the effect of the test compound on the cells having the predetermined characteristic.

2. The microfluidic system of claim 1, further comprising a connecting channel between the cell sorting system and the screening system for conveying selected cells from the cell sorting system to the screening system.

3. The microfluidic system of claim 1, wherein the cell sorting system comprises:

a first duct for conveying a stream of suspended cells in a carrier liquid, comprising an inlet, a first outlet and a second outlet;

a sensor for sensing a predetermined characteristic in a particle and one of a size and a velocity of a particle;

a side channel in communication with the first duct;

a sealed chamber positioned adjacent to the side channel, wherein the carrier fluid forms a meniscus in the side channel to separate the sealed chamber from the carrier fluid; and

an actuator for modifying the pressure in the sealed chamber to deflect the meniscus when the sensor senses said predetermined characteristic, whereby the deflection of the meniscus causes the cells having said predetermined characteristic to flow into the second outlet while cells that do not have said predetermined characteristic flow into the first outlet.

4. The microfluidic system of claim 3, wherein the cell sorting system further comprises a buffer for absorbing pressure variations in the first duct.

5. The microfluidic system of claim 3, wherein the actuator comprises a source of pressurized gas.

6. The microfluidic system of claim 3, wherein the sealed chamber comprises a movable wall.

7. The microfluidic system of claim 5, wherein the actuator comprises a displacement actuator for moving the movable wall of the sealed chamber to modify the pressure in the sealed chamber.

8. The microfluidic system of claim 7, wherein the actuator comprises one of an electromagnetic actuator and a piezoelectric element.

9. A system for screening a test compound, comprising:

a particle sorting system for separating target particles from a sample containing the target particles, said particle sorting system comprising:

a first duct for conveying a sample, comprising an inlet, a first outlet and a second outlet;

a sensor for sensing a predetermined characteristic in a target particle;

a side channel in communication with the first duct;

a sealed chamber positioned adjacent to the side channel, wherein a carrier fluid in the first duct forms a meniscus in the side channel to separate the sealed chamber from the carrier fluid; and

an actuator for modifying the pressure in the sealed chamber to deflect the meniscus when the sensor senses said predetermined characteristic, whereby the deflection of the meniscus causes the target particle having said predetermined characteristic to flow into the second outlet while particles that do not have said predetermined characteristic flow into the first outlet;

a mixing and incubation region connected to the second outlet for receiving the target particles and a test compound and for mixing the test compound with the target particles; and

a detection region for detecting the effect of the test compound on the target particles.

10. A method of testing an effect of a compound on a target cell, comprising

sorting a set of cells based on a predetermined characteristic,

conveying cells having the predetermined characteristic through a connecting channel to a mixing region; and

introducing the compound to the mixing region.

11. A method of screening primary cells, comprising:
sorting a set of cells to separate a subpopulation of cells from the set;
adding a compound to the subpopulation of cells; and
analyzing the subpopulation to determine the effect of the compound on the subpopulation of cells.

12. A method of analyzing a side effect of a compound, comprising:
providing a set of primary cells;
adding the compound to the set of primary cells;
measuring the primary cells to determine activity caused by the compound;
separating primary cells having the activity from primary cells not having the activity.

13. The method of claim 10, wherein the predetermined characteristic is the presence of a desired marker.

14. The method of claim 13, wherein the desired marker is an antibody, enzyme, substrate, cofactor, fluorescent dye, or reporter gene.

15. A method for screening for the ability of a compound to modulate the activity of a cell, wherein said cell is contacted with a test compound and said cells response to said test compound is monitored using the microfludic system of claim 1.

16. A method of isolating a subpopulation of cells from a cell population using a microfluidic system comprising;
identifying cells from a population that have a desired phenotype; and
isolating said cells from cells that do not have the desired phenotype.

17. The method of claim 16, wherein said cell population is culture of isolated primary cells.

18. The method of claim 16, wherein the cell population is a cell culture.

19. A method of isolating a subpopulation of cells to be used in cell transplantation comprising;
identifying cells with a desired phenotype;
isolating said cells using a microfludic device;
thereby isolating a subpopulation of cells to be used in transplantation.

20. A method of isolating a supbpopulation of cells to be genetically modified comprising,
identifying a subpopulation of cells based on a desired phenotype in a cell population;
isolating said cells using a microfludic device;
thereby isolating a subpopulation of cells to be genetically modified.

21. The method of claim 20, wherein said cells that are isolated to be genetically modified are reimplanted in a subject.

22. A method of isolating a subpopulation of cells comprising,
identifying a subpopulation of cells displaying a cell cycle stage specific marker;
isolating said cells using a microfludic device;
thereby isolating a subpopulation of cells that are in the same phase of the cell cycle.

23. A method of testing the ability of a compound to modulate an enzymatic activity in vivo comprising;
administering to a population of cells a compound that when acted upon by said cellular enzyme becomes fluorescent; and
measuring said cells fluorescence to determine the ability of the compound to modulate the activity of the enzyme.